REMARKS

Claims 1-23 are pending in the present application. In the Office Action mailed November 10, 2004, the Examiner rejected claims 1-6, 10-21, and 23 under 35 U.S.C. §102(b) as being anticipated by Kaufman et al. (USP 4,970,457). Applicant appreciates the indication that claims 7-9 and 22 include patentable subject matter.

Before addressing the claims and corresponding rejections in detail, Applicant would like to highlight some overall distinctions regarding the claimed invention and Kaufman et al. Specifically, the Examiner cited Kaufman et al. as teaching that which is called for in claims 1-6, 10-21, and 23. However, Kaufman et al. is directed to a very different purpose and, thus, teaches a system and method that varies greatly from the claimed invention.

The present invention is directed to a system and method to reduce induced RF power in high field imaging using a modulated pulse sequence. Specifically, the present invention recognizes that while high magnetic field imaging can generally provide a significant improvement in SNR, it is also burdened by a quadratic increase in peak and integrated RF power as a function of field strength. Therefore, the present invention is focused on providing adequate coverage at high field strengths but with reduced induced RF power so as to not adversely affect SNR, contrast, and resolution.

On the other hand Kaufman et al. is directed to providing a magnetic field/magnet calibration method to compensate for variations in the B_0 field during imaging that can reduce contrast and resolution. *See* Kaufman et al., Abstract. Therefore, Kaufman et al. teaches a system and method to create "calibration data" to compensate for variations in the "static" magnetic field. *See* col. 12, ln. 67 to col. 13, ln. 24. Specifically, Kaufman et al. teaches a method of post-acquisition k-space correction based upon templates generated for every TR cycle. *See* col. 13, lns. 2-5 and lns. 16-24.

Accordingly, the claimed invention and Kaufman et al. differ significantly is purpose, method, system, and result. The claimed invention is a system and method to reduce the RF power induced in conjunction with high magnetic field imaging. However, Kaufman et al. teaches a system and method for post-acquisition correction of errors in a reconstructed image resulting from variations in the homogeneity of the "static" B_0 field. With this distinction is mind, Applicant requests consideration of the detailed remarks hereinafter setting forth patentable distinctions between claims 1–23 and Kaufman et al.

Claim 1 calls for "[a]n MR pulse sequence designed to reduce induced RF power with multi-phase flip angles." The pulse sequence includes at least two phases including "an initial contrast preserving phase" and "a ramp down phase." During the initial contrast preserving phase a number of pulses with relatively high flip angle that is relatively constant are played out. The Examiner cited column 12, lines 1-6 of Kaufman et al. as teaching this initial contrast preserving phase. However, the cited section discloses that during multi-echo (ME) process a reduced magnitude flip angle may be applied to a selected slice to regenerate a new spin echo signal without phase encoding. Specifically, Kaufman et al. teaches application of "a low magnitude flip angle to the slice after 904 so as to regenerate and acquire a fresh spin echo (without phase encoding)." Col. 12, lns. 3–6. It does not teach an "initial contrast preserving phase," as claimed. That is, a single pulse with a given flip angle, reduced or otherwise, would not serve to "preserve contrast," as claimed. The reduced magnitude flip angle is used to regenerate an echo without phase encoding – not preserve contrast.

Additionally, claim 1 calls for "a ramp down phase" that includes "a number of pulses with a flip angle less than that of the flip angle of the number of pulses in the initial contrast preserving phase and that decreases over time." The Examiner cited column 12, lines 52-66 as support for rejecting claim 1. However, the cited section discloses a method of post-acquisition data correction to correct for "drift" in the "static" B_0 field, as taught by Yao et al. This method and the augmented version of the Yao et al. technique disclosed in column 12, line 67 to column 13, lines 24, which is the invention disclosed by Kaufman et al., does not teach or suggest the claimed "ramp down phase," that in conjunction with the contrast preserving phase, serves to reduce induced RF power while sustaining contrast in the reconstructed image. One of ordinary skill in the art will readily recognize that post-acquisition correcting of errors attributable to variation in the B_0 field is substantially unrelated to reducing induced RF power during data acquisition.

Furthermore, Kaufman et al. and the summary of Yao et al. only teach a technique for correcting errors induced by variation in the B_0 field after data acquisition is complete. These techniques are post-data-acquisition correction techniques and do not regard or include "a number of pulses with a flip angle less than that of the flip angle of the number of pulses in the initial contrast preserving phase and that decreases over time," as claimed. By the time these correction techniques are applied all pulses with flip angles have already been applied and data acquired. Therefore, while the claimed "ramp down phase" occurs during the data acquisition process,

Kaufman et al. teaches a process of correcting errors after data acquisition is complete. *See* col. 12, ln. 52 to col. 13, ln. 24.

Therefore, Kaufman et al. does not teach or suggest that which is called for in claim 1. Kaufman et al. teaches post-acquisition data correction of errors attributable to inhomogenity of the B_0 field and does not teach or suggest any "an initial contrast preserving phase" or "a ramp down phase" to reduce induced RF power, as claimed. Accordingly, claim 1 is patentably distinct from the art of record. Furthermore, claims 2-10 are in condition for allowance at least pursuant to the chain of dependency.

Regarding claim 11, the Examiner addressed the claim in conjunction with claim 1. However, the Examiner did not address the specific elements of claim 11. The Examiner did not cite any specific sections separate from those addressed with respect to claim 1. As such, for the reasons previously stated, claim 11 is patentably distinct from the art of record.

Moreover, claim 11 further calls for subject matter not disclosed by Kaufman et al. As previously explained, Kaufman et al. discloses a post-acquisition method to correct errors caused by variations in the B_0 field. Kaufman et al. teaches that a "k-space template is generated for every TR interval" and utilized to perform post-data-acquisition correction of errors resulting from variations in the "static" B_0 field. Col. 12, ln. 67 to col. 13, ln. 24. Therefore, Kaufman et al. is concerned with each TR interval and interaction with T1 recovery periods. *See* col. 8, lns. 31-40. However, claim 11 calls for "[a] method of reducing RF power induced in a patient in high field MR imaging." The method includes "applying a set of RF pulses with relatively high flip angles to preserve T2 contrast before a given TE" and "after the given TE, applying a set of RF pulses with varying flip angles that are lower than that applied before the given TE." As further illustrated by the distinct criteria each is focused upon, Kaufman et al. is substantially unrelated to that which is claimed. Again, in particular, Kaufman et al. discloses a technique for post-data acquisition correction of errors induced by variations in the B_0 field whereas the claimed invention is directed to reducing induced RF power at high magnetization.

Accordingly, claim 11 is patentably distinct from the art of record. Therefore, claims 12-17 are in condition for allowance pursuant to the chain of dependency.

Regarding claim 18, the Examiner stated that "Kaufman discloses a relaxation prolongment phase" in column 12, lines 1-66. However, Applicant does not believe any such disclosure is included within column 12 because, as previously stated, column 12, like Kaufman et al. as a whole, is directed to post-acquisition correction of errors reduced by variations in the B_0 field and not reducing induced RF power. Furthermore, claim 18 calls for

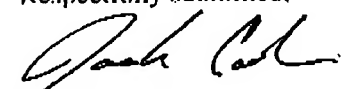
more than just an application of a relaxation prolongment phase." That is claim 18, in part, calls for "a computer programmed to: (1) apply a set of high nutation RF pulses to establish a desired T2-weighted contrast at an effective echo time (TEeff), (2) apply a set of refocusing RF pulses having lower nutation than that of the high nutation RF pulses, (3) apply another set of RF pulses designed to prolong relaxation and (4) acquire data throughout the RF pulse application." (Enumeration added to indicate separate elements but not order). Therefore, claim 18 does not only call for the application of a set of RF pulses designed to prolong relaxation but also to "apply a set of high nutation RF pulses to establish a desired T2-weighted contrast at an effective echo time (TEeff)," "apply a set of refocusing RF pulses having lower nutation than that of the high nutation RF pulses," and "acquire data throughout the RF pulse application." Applicant does not believe the cited section of Kaufman et al. nor Kaufman et al. as a whole teaches or suggest that claimed.

Therefore, for at least these reasons, as well as the reasons previously articulated with respect to claims 1 and 11, claim 18 is patentably distinct from the art of record. Accordingly, claims 19-23 are in condition for allowance at least pursuant to the chain of dependency.

Therefore, in light of at least the foregoing, Applicant respectfully believes that the present application is in condition for allowance. As a result, Applicant respectfully requests timely issuance of a Notice of Allowance for claims 1-23.

Applicant appreciates the Examiner's consideration of these Remarks and cordially invites the Examiner to call the undersigned, should the Examiner consider any matters unresolved.

Respectfully submitted,



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